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वस्त्रादि — रंग के पक्केपन के परीक्षण

भाग C06 घर पर तथा व्यवसायिक रूप से धुलाई करने पर रंग का पक्कापन

Indian Standard

TEXTILES — TESTS FOR COLOUR FASTNESS

PART C06 COLOUR FASTNESS TO DOMESTIC AND COMMERCIAL LAUNDERING

ICS 59.080.01

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NEW DELHI 110002

August 2009 **Price Group 8**

Chemical Methods of Test Sectional Committee, TXD 05

NATIONAL FOREWORD

This Indian Standard (Part C06) which is identical with ISO 105-C06 : 1994 Textiles — Tests for colour fastness — Part C06: Colour fastness to domestic and commercial laundering' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Chemical Methods of Test Sectional Committee and approval of the Textile Division Council.

This standard supersedes IS 13025 : 1991 'Method for determination of colour fastness of textile materials to domestic and commercial laundering'.

Colour fastness of dyed/printed textile materials to various agencies during their further treatment or actual use is an important performance requirement from the viewpoint of the user or consumer. The various agencies to which textile materials may be subsequently subjected may include water, acids, alkalis, organic solvents, washing, laundering, drycleaning, perspiration, light, gaseous fumes, bleaching, rubbing, carbonizing, felting, etc and the colour of textile materials should be fast to these agencies and should not change considerably. The colour should also not bleed and stain the adjacent fabrics which are subjected to these agencies along with coloured fabrics. The colour fastness property of coloured textiles is, therefore, measured in terms of colour fastness ratings with respect to change in colour and/or staining of adjacent fabrics.

Since colour fastness is one of the most important requirement for export of textiles, it is considered essential that Indian Standards related to colour fastness are completely harmonized with International Standards. The various Indian Standards on colour fastness testing, are, therefore, being revised to align them with the corresponding International Standards and are being published in Parts A to Z.

This standard is intended to test colour fastness of textile materials to domestic or commercial laundering procedures used for normal household articles. Industrial and hospital articles may be subject to special laundering procedures which may be more severe in some respects.

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker in the International Standards, while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards, which are to be substituted in their respective places, are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 105-A01 : 1994 Textiles — Tests for colour fastness — Part A01: General principles of testing	IS/ISO 105-A01 : 1994 Textiles — Tests for colour fastness: Part A01 General principles of testing	Identical
ISO 105-A02 : 1993 Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour	IS/ISO 105-A02 : 1993 Textiles — Tests for colour fastness: Part A02 Grey scale for assessing change in colour	do
ISO 105-A03 : 1993 Textiles — Tests for colour fastness — Part A03: Grey scale for assessing staining	IS/ISO 105-A03 : 1993 Textiles — Tests for colour fastness: Part A03 Grey scale for assessing staining	do

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Indian Standard

TEXTILES — TESTS FOR COLOUR FASTNESS

PART C06 COLOUR FASTNESS TO DOMESTIC AND COMMERCIAL LAUNDERING

ICS 59.080.01

1 Scope

1.1 This part of ISO 105 specifies methods intended for determining the resistance of the colour of textiles of al! kinds and in all forms to domestic or commercial laundering procedures used for normal household articles. Industrial and hospital articles may be subjected to special laundering procedures which may be more severe in some respects.

1.2 The colour loss and staining resulting from desorption and/or abrasive action in one single (S) test closely approximates to one commercial or domestic laundering. The results of one multiple (M) test may in some cases be approximated by the results of up to five domestic or commercial launderings at. temperatures not exceeding 70 °C. The M tests are more severe than the S tests because of an increase in mechanical action.

1.3 These methods do not reflect the effect of optical brighteners present in commercial washing products.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions -of this part of ISO 105. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 105 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of I EC and ISO maintain registers of currently valid International Standards.

ISO 105-A01:1994, *Textiles — Tests for colour fastness — Part A01: General principles of testing.*

ISO 105-A02:1993, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour.*

ISO 105-A03:1993, *Textiles — Tests for colour fastness* — Parf *A03: Grey scale for assessing staining.*

ISO 105-F:1985, *Textiles — Tests for colour fastness — Part F: Standard adjacent fabrics.*

ISO 105-F10:1989, *Textiles — Tests for colour fastness — Part F10: Specification for adjacent fabric: Multifibre.*

ISO 3696:1987, *Water for analytical laboratory use — Specification and test methods.*

3 Principle

A specimen of the textile in contact with specified adjacent fabric or fabrics is laundered, rinsed and dried. Specimens are laundered under appropriate conditions of temperature, alkalinity, bleaching and abrasive action such that the result is obtained in a conveniently short time. The abrasive action is accomplished by the use of a low liquor ratio and an appropriate number of steel balls. The change in colour of the specimen and the staining of the adjacent fabric or fabrics are assessed by comparison with tha grey scales.

4 Apparatus, materials and reagents

4.1 Suitable mechanical device, consisting of a water bath containing a rotatable shaft which supports, radially, stainless steel containers (75 mm ± 5 mm diameter x 125 mm ± 10 mm high) of capacity 550 ml ± 50 ml, the bottom of the containers being 45 mm ± 10 mm from the centre of the shaft.

The shaft/container assembly is rotated at a frequency of (40 + 2) min^{-1}. The temperature of the water bath is thermostatically controlled to maintain the test solution at the prescribed temperature ± 2 °C.

NOTE 1 Other mechanical devices may be used for this test, provided that comparable results are obtained.

4.2 Non-corrodibie (stainless) steel balls, approximately 6 mm in diameter.

4.3 Adjacent fabrics (see ISO 105-A01:1994, 8.3)

Either:

4.3.1 A multifibre adjacent fabric, complying with ISO 105-F10, according to the temperature used:

— a multifibre adjacent fabric (DW) containing wool and acetate (tests at 40 °C and 50 °C and in certain cases, to be indicated in the test report, also at 60 °C);

—- a multifibre adjacent fabric {TV) not containing wool and acetate (in certain tests at 60 °C, and in all tests at 70 °C and 95 °C).

Or:

4.3.2 Two single-fibre adjacent fabrics, complying with the relevant section F01 to **F08** of ISO 105-F:1985. One of the adjacent fabrics shall be made of the same kind of fibre as that of the textile to be tested, or that predominating in the case of blends, and the second piece made of the fibre as indicated in table 1 or, in the case of blends, of the kind of fibre second in order of predominance, or as otherwise specified.

Table 1 — Pairs of adjacent fabrics

ff first piece is:	**Second piece to be:**	
	For tests A and B	**For tests C, p and E**
cotton	wool	viscose
wool	cotton	—
Silk	cotton	—
viscose	wool	cotton
linen	wool	viscose
acetate and triacetate	viscose	viscose
polyamide	wool or cotton	cotton
polyester	wool or cotton	cotton
acrylic	wool or cotton	cotton

4.3.3 If required, a non-dyeable fabric (e.g. polypropylene).

4.4 Detergent, without optical brightener. A minimum volume of 1 litre of detergent solution shall be prepared, because of possible lack of homogeneity of the detergent powder.

Either of two detergents may be used:

a) AATCC Reference Detergent WOB.

The detergent is low-sudsing; the surfactants composing the detergent are anionic, with a small proportion of non-ionic, and are biodegradable. It has the following properties and composition:

Composition:	Mass fraction (%)
Linear alkylsulfonate, sodium salt (LAS)	14,00 ± 0,02
Alcohol ethoxylate	2,30 ± 0,02
Soap — high molecular mass	2,50 ± 0,02
Sodium tripolyphosphate	48,00 ± 0,02
Sodium silicate (Si02/Na20 = 2/1)	9,70 ± 0,02
Sodium sulfate	15,40 ± 0,02
Carboxymethylcellulose (CMC)	0,25 + 0,02
Water	7,85 ± 0,02
	100.00

b) In countries where perborates are used in laundering, the ECE Reference Detergent for colour fastness testing, without optical brightener, may be used.

NOTE 2 Information on the availability of this detergent can be obtained from national standards organizetions.

The composition of the ECE Detergent is as follows:

Composition:	Mass fraction (%)
Linear sodium alkyibenzenesuifonate (mean length of alkane chain C 11,5)	8,0 ± 0.02
Ethoxylated tallow alcohol (14 EO)	2,9 ±0,02
Sodium soap, chain length C12 - C16 : 13% - 26% C18 - C22 : 74 % - 87 %	3,5 ± 0,02
Sodium tripolyphosphate	43,7 ± 0.02
Sodium silicate (Si02/Na20 = 3.3/1)	7,5 ± 0.02
Magnesium silicate	1,9 + 0,02
Carboxymethylceliuiose (CMC)	1,2 ± 0,02
Ethylenediaminetetraacetic acid (EDTA), sodium salt	0,2 ± 0,02
Sodium sulfate	21,2 + 0,02
Water	9,9 ± 0,02
	100,00

4.5 If required, **sodium carbonate** (Na_2C0_3).

4.6 Sodium hypochlorite or lithium hypochlorite

The pH value and available chlorine content of a large number of tradenamed solutions of sodium hypochlorite (NaOCI) vary from pH 9,8 to 12,8 and the Cl_2 content from 40 g/l to 160 g/l. The actual available chlorine shall be determined before use and the following method is suggested.

Pipette a 1,00 ml portion of the stock sodium hypochlorite solution into a conical flask and dilute to 100 ml with grade 3 water (4.8). Add 20 ml of 294 g/l sulfuric acid (H_2S0_4) solution and 6 ml of 120 g/l potassium iodide (Kl) solution. Titrate with standard volumetric sodium thiosulfate solution, c($Na_2S_20_3.5H_20$) »0,1 mot/I.

The available chlorine (Cl_2) content is given, as a percentage by mass, by the formula

$$\frac{V \times c \times 0{,}035\,5}{V_o \times \varrho_o} \times 100$$

where

V_o is the volume, in milliliters. of sodium hypochlorite solution taken;

Q_o is the density, in grams per milliliter of the sodium hypochlorite solution;

V is the volume, in milliliters, of sodium thiosulfate solution used;

c is the amount-of-substance concentration, in moles per litre, of the sodium thiosulfate solution.

4.7 If required, **sodium perborate tetrahydrate** ($NaB0_3.4H_20$).

4.8 Grade 3 water, complying with ISO 3696.

4.9 Grey scale for assessing change in colour in accordance with ISO 105-A02 and **grey scale for assessing staining** in accordance with ISO 105-A03.

4.10 If required for souring treatment, **acetic acid solution** containing 0,2 g of glacial acetic acid per litre.

5 Test specimen

5.1 If the textile to be tested is fabric, either:

a) attach a specimen 100. mm x40 mm to a piece of the multifibre adjacent fabric (4.3.1), also 100 mm x 40 mm, by sewing along one of the shorter edges, with the multifibre adjacent fabric next to the face side of the specimen, or

b) attach a specimen 100 mm x 40 mm between the two single-fibre adjacent fabrics (4.3.2) by sewing along one of the shorter edges.

5.2 Yarn may be knitted into fabric and tested in this form. Where yarns or loose fibres are to be tested, take a mass of the yarn or loose fibre approximately equal to one-half of the combined mass of the adjacent fabrics and either:

a) place it between a 100 mm x 40 mm piece of the multifibre fabric (4.3.1) and a 100 mm x 40 mm, piece of the non-dyeable fabric (4.3.3), and sew them along all four sides (see ISO 105-A01:1994 9.6.3.4);

or:

b) place it between 100 mm x 40 mm pieces of the two specified single-fibre fabrics (4.3.2) and sew them along all four sides.

6 Test procedures

6.1 Prepare the wash liquor by dissolving 4 g of detergent per litre of water (4.8). For all C, D or E tests, adjust the pH as stated in table 2 by the addition of approximately 1. g of sodium carbonate per litre of solution. The liquor should be cooled to 20 °C before the pH is measured. For the A and B tests, nc adjustment of pH is required.

6.2 For tests where perborate *{4.1)* is employed, prepare the washing solution containing perborate at the time of use by heating the liquor to a maximum temperature of 60 *C for not more than 30 min.

6.3 For tests D3S and D3M, add tc the wash liquor sufficient sodium hypochlorite solution (4.6) or lithium hypochlorite solution (4.6) to provide the concentration of available chlorine specified in table 2.

6.4 Add to each stainless steel container (4.1) the volume of wash liquor specified in table 2. Except for tests D2S and E2S, adjust the temperature of the liquor to within ± *2 ºC* of the specified temperature and :hen place in the container the specimen together with the specified number of steel balls (4.2). Close the container and operate the machine at the temperature and for the time specified in table 2.

6.5 For tests D2S and E2S, place the specimen in the container at a temperature of approximately 60 °C, close the container and raise tne temperature to within ± *2 º*C of the specified temperature in not more than 10 min. Begin timing the test as soon as the container is closed. Operate the machine at the temperature and for the time specified in table 2.

6.6 For all tests, remove the composite specimen at the end of the wash and rinse twice for 1 min in two separate 100 ml portions of water (4.8) at 40 *C.

6.7 in countries where the practice is to sour at the end of the washing operation, the following optional operation may be conducted.

Treat each composite specimen in a 100 mi portion of acetic acid reagent (4.10) for 1 min at 30 °C. Then rinse each composite specimen in a 100 ml portion of water (4.8) for 1 min at 30 °C.

6.8 For all methods, extract the excess water from the composite specimen.

6.9 For all methods, dry the specimen by hanging it in air at a temperature not exceeding 60 °C, with the parts in contact only at the line of stitching.

6.10 Assess the change in colour of the specimen and the staining of the adjacent fabric using the grey scales.

Table 2 — Test conditions

Test No.	**Temperature** ºC	**Liquor volume** ml	**Available chlorine** %	**Sodium perborate** g/l	**Time** min	**Number of steel balls**	**Adjust pH to**
A1S	40	150	None	None	**30**	10 1)1	Not adjusted
AIM	40	150	None	None	**45**	10	Not adjusted
A2S	40	150	None	1	**30**	10 1)	Not adjusted
BIS	50	150	None	None	**30**	25 1)	Not adjusted
B1M	50	150	None	None	**45**	50	Not adjusted
B2S	50	150	None	1	**30**	25 1)	Not adjusted
C1S	60	50	None	None	**30**	25	10.5 ± 0.1
C1M	60	50	None	None	**45**	50	10.5 ± 0,1
C2S	60	50	None	1	**30**	25	10,5 ± 0.1
D1S	70	50	None	None	**30**	25	10,5 ± 0,1
D1M	70	50	None	None	**45**	100	10.5 ±0,1
D2S	70	50	None	1	**30**	25	10,5 ± 0,1
D3S	70	50	0,015	None	**30**	25	10,5 ±0,1
D3M	70	50	0.015	None	**45**	100	10,5 ± 0.1
E1S	95	50	None	None	**30**	25	10,5 ± 0,1
E2S	95	50	None	1	**30**	25	10,5 ±0,1

1) For delicate fabrics and articles of wool or silk or blends containing these fibres, steel balls are not used in the test. Record the use of steel balls in the test report [see 7 g)].

7 Test report

The test report shall include the following information:

a) the number and year of publication of this part of ISO 105, i.e. ISO 105-C06:1994;

b). all details necessary for complete identification of the sample tested;

c) the numerical grey scale rating for the change in colour of tne specimen;

d) if single-fibre adjacent fabrics were used, the numerical grey scale rating for staining of each kind of adjacent fabric used;

e) if a multifibre adjacent fabric was used, the type of multifibre adjacent fabric used and the numerical grey scale rating for staining of each type of fibre in the multifibre adjacent fabric;

f) the number of the method of test used (as listed in table 2);

g) whether steel balls were used in some of the A or B tests;

h) whether souring treatment in acetic acid reagent as described in 6.7 was conducted;

i) whether the AATCC Reference Detergent WOB or the ECE Reference Detergent for colour fastness testing, without optical brightener, was used.

TECHNICAL CORRIGENDUM 1

Technical Corrigendum 1 to International Standard ISO 105-C06:1994 was prepared by Technical Committee ISO/TC 38, *Textiles,* Subcommittee SC 1, *Tests for coloured textiles and colorants.*

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in Table 1, delete "linen" in the left-hand column and "wool" and "viscose" in the same line in the centre and right-hand columns.

In subclause 4.3, replace "see ISO 105-A01:1994, 8.3" by "see ISO 105-A01:1994, 8.2".

TECHNICAL CORRIGENDUM 2

Technical Corrigendum 2 to International Standard ISO 105-006:1994 was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC1, Tests for coloured textiles and colorants.

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Scope

There is an additional paragraph to the Scope as follows:

> **"1.4** These methods are designed for the detergents and bleach systems given. Other detergents and bleach systems may require different conditions and levels of ingredients."

NATIONAL ANNEX A

(National Foreword)

EXTRACTS FROM INTERNATIONAL STANDARDS

A-1 Extracts from Textiles — Tests for colour fastness — Part F01: Specification for wool adjacent fabric

The fabric shall have the following properties.

Mass per unit area: 125 ± 5 g/m^2.

Colour specification: The CIE chromaticity coordinates for CIE standard illuminant D_{65} and CIE 1964 supplementary standard colorimetric observer (10° observer).

x_{10} = 0,337 ± 0,002
y_{10} = 0,356 ± 0,002
with the luminance factor
y_{l0} = 72 ± 2

The yellowness (G) of the fabric shall be G = 25 ± 2 when determined by the formula:

$$G= \frac{1{,}301\ X_{10} - 1{,}149\ Z_{10}}{V_{10}} \text{ x } 100$$

NOTE: Formula described in DIN 6167.

The pH of the aqueous extract shall be 7 ± 0,5 when determined by the method described in ISO 3071.

The mass fraction of residual dichloromethane -soluble matter shall be (0,5 ± 0,1) percent.

The alkali solubility shall not exceed 18 percent when determined by the method in ISO 3072.

A-2 Extracts from Textiles - Tests for colour fastness — Part F02: Specification for cotton and viscose adjacent fabric

A-2.1 Specification for Cotton and Viscose Adjacent Fabric Cotton

The fabric shall have the following properties:

Mass per unit area: (115 ± 5) g/m^2 when determined in accordance with ISO 3801.
Whiteness value: Y_{10} - 80 ± 2
W_{10} = 73 ± 2
7_{10} = -1 ± 1 (that is -2 to 0)

Measurements shall be made with specular included in accordance with ISO 105-J03, excluding 0/45 (45/0). Luminance (Y_{10}), Whiteness ($H/_{10}$) and Tint (T_{10}) values shall be calculated using CIE standard iilluminant D_{65} and CIE 1964 supplementary standard colorimetric observer (100 observer).

pH of the aqueous extract shall be 7,0 ± 0,5 when determined by the method described in ISO 3071.

A-2.2 Viscose

The fabric shall have the following properties:

Mass per unit area: (140 ± 5) g/m^2 when determined in accordance with ISO 3801.

Whiteness value: Y_{10} = 85± 3

W_{10} = 58 ± 4

T_{10} = -1 ± 1 (that is -2 to 0)

Measurements shall be made with specular included in accordance with ISO 105-J03, excluding 0/45 (45/0). Luminance (Y_{10}), Whiteness (W_{10}) and Tint (7_{10}) values shall be calculated using CIE standard illuminant D_{65} and CIE 1964 supplementary standard colorimetric observer (100 observer).

A-3 Extracts from Textiles — Tests for colour fastness — Part F03: Specification for polyamide adjacent fabric

The fabric shall have the following properties.

Mass per unit area: 130 ± 5 g/m^2.

Whiteness value: $Y_{10} = 86 \pm 2$

$W_{10} = 65 \pm 2$

$T_{10} = -1 \pm 1$ (i.e.-2 to 0)

Measurements shall be made with specular included in accordance with ISO 105-J01, excluding 0/45 (45/0). Luminance (Y_{10}), Whiteness (W_{i0}) and Tint (T_{10}) values shall be calculated using CIE standard illuminant D_{65} and CIE 1964 supplementary standard colorimetric observer (10° observer).

The pH of the aqueous extract shall be 7 ± 0,5 when determined by the method described in ISO 3071.

A-4 Extracts from Textiles — Tests for colour fastness — Part F04: Specification for polyester adjacent fabric

The fabric shall have the following properties.

Mass per unit area: 130 ± 5 g/m^2 .

Whiteness value: $Y_{10} = 86 \pm 2$

$W_{10} = 70 \pm 2$

$T_{10} = 0 \pm 1$ (i.e.-1 to1)

Measurements shall be made with specular included in accordance with ISO 105-J01, excluding 0/45 (45/0). Luminance (Y_{10}), Whiteness (W_{10}) and Tint (T_{10}) values shall be calculated using CIE standard illuminant D_{65} and CIE 1964 supplementary standard colorimetric observer {10° observer).

The pH of the aqueous extract shall be 7 ± 0,5 when determined by the method described in ISO 3071.

A-5 Extracts from Textiles — Tests for colour fastness — Part F05: Specification for acrylic adjacent fabric

The fabric shall have the following properties.

Mass per unit area: 135 ± 5 g/m^2.

Whiteness value: $Y_{10} = 86 \pm 2$

$W_{10} = 67 \pm 2$

$T_{10} = 1 \pm 1$ (i.e. 0 to 2)

Measurements shall be made with specular included in accordance with ISO 105-J01, excluding 0/45 (45/0). Luminance (Y_{10}), Whiteness (W_{10}) and Tint (T_{10}) values shall be calculated using CIE standard illuminant Dg_5 and CIE 1964 supplementary standard colorimetric observer (10° observer).

The pH of the aqueous extract shall be 7 ± 0,5 when determined by the method described in ISO 3071.

A-6 Extracts from Textiles — Tests for colour fastness — Part F06: Specification for silk adjacent fabric

The fabric shall have the following properties.

Mass per unit area: 60 ± 3 g/m^2.

Whiteness value: Y_{10} = 91 ± 2
W_{10} = 79 ± 3
T_{10} = -1 ± 1 (i.e. -2 to 0)

Measurements shall be made using the instrument geometry *d/0,* specular included in accordance with ISO 105-J01. Luminance (Y_{t0}), Whiteness (W_{10}) and Tint (T_{10}) values shall be calculated using CIE standard illuminant Des and CIE 1964 supplementary standard colorimetric observer {10° observer).

The pH of the aqueous extract shall be 7,8 ± 0,5 when determined by the method described in ISO 3071.

The residual matter, after extraction with diethyl ether shall not exceed 0,5 percent.

The alkali solubility shall not exceed 19 percent *(m/m)* when determined by the method given in ISO 3072.

A-7 Extracts from Textiles — Tests for colour fastness — Part F07: Specification for secondary acetate adjacent fabric

The fabric shall have the following properties.

Mass per unit area: 160 ± 5 g/m^s.

Whiteness value: Y_{10} = 86 ± 2

W_{10} = 69 ± 2

T_{10} = -1 ± 1 (i.e. -2 to 0)

Measurements shall be made with specular included in accordance with ISO 105-J01, excluding 0/45 (45/0). Luminance (Y_{10}), Whiteness *{W_{10})* and Tint (T_{10}) values shall be calculated using CIE standard illuminant D_{65} and CIE 1964 supplementary standard colorimetric observer (10° observer).

The pH of the aqueous extract shall be 7 ± 0,5 when determined by the method described in ISO 3071.

A-8 Extracts from Textiles — Tests for colour fastness — Part J01: General principles for measurement of surface colour

A-8.1 Principle

Materials of an opaque or nearly opaque nature (but not translucent) are measured by reflectance methods in order to obtain a numerical representation of the colour of the specimen.

NOTES: 1 Proper equipment set-up, standardization of the colour measuring instrument and proper presentation of the test specimens to the instrument are required to achieve consistent, reliable and meaningful reflectance measurement results.

2 In general, instrumental colour measurement procedures are dictated by the type of specimen to be measured and the instrument with which it will be measured. Many types of colour measuring Instrumentation are available, differing in such features as area-of-view, illumination method, and geometry. The user is cautioned that conflicting results may be obtained on comparisons of data acquired on instruments of different designs.

A-8.2 Apparatus

A-8.2.1 Reflectance colour measuring instrument, for illuminating a specimen and measuring the amount of light which is reflected from the surface of the specimen. Illumination is usually polychromatic (white light); however monochromatic mode is acceptable for non-fluorescent specimens. Reflectance colour measuring instruments may be broadly divided into two groups:

a) Spectrophotometers (typically diffuse/0, using polychromatic illumination) separate and measure the spectrum of light reflected from the specimen relative to a reference white at regular intervals {wavelength intervals of 5 nm, 10 nm and 20 nm are most common). These data may be used to calculate the desired tristimulus values *(X, Y, Z)* for any given illuminant and observer. Some spectrophotometers (typically 0/diffuse) illuminate the sample with monochromatic light and measure the amount of light reflected from the surface as the sample is illuminated at regular wavelength intervals.

b) Colorimeters measure the tristimulus values (X, V, Z) directly through broadband filters which are designed to produce colorimetric values for one illuminant and observer (typically C/2). Measurement of reflectance factors at specific wavelengths is not possible with a colorimeter.

Diffuse/0 (sphere) instruments illuminate the specimen indirectly when the specimen is placed against a port opening into a diffusely illuminated sphere and view the specimen at an angle between 0°and 10° from the perpendicular. This arrangement is designed to capture all light reflected from the specimen. Some sphere instruments with a viewing angle greater than 0° include a specular port which permits the inclusion of exclusion of the specular reflectance.

0/diffuse (sphere) instruments are similar, but the path of illumination and viewing are reversed. This methods iluminates the sample at an angle between 0° and 10° and measures the amount of light reflected from the surface into the sphere.

Instruments with 45/0 (or 0/45) geometry illuminate the specimen at the first angle and view the specimen at the second. These two geometries can be either circumferential (viewing or illuminating at 45 to the specimen in a complete circle) or directional. For most textile samples, either 45/0 or 0/45 yield equivalent results.

A-8.2.2 White calibrated standard, with which to standardize the instrument. The colorimetric values for this calibration standard are stored in the instrument or the software and require only that a specific standard be used to standardize the instrument. The correct white standard is usually identified with a serial number.

A-8.2.3 Black standard, required for some instruments. It may be of zero reflectance (a light trap) or it may be calibrated, in which case the comments in A-8.2.2 shall apply.

A-8.3 Procedure

A-8.3.1 General

a) Collect and prepare specimen, noting any special sampling and/or conditioning procedures that may be required as described in A-8.3.3.

b) Standardize instrument according to A-8.3.2. Maintain a record of the procedure and the results of any verification standards measured.

c) Present specimen to colour measuring instrument following any special techniques required for the type of material being measured per section A-8.3.4.

d) Measure the colour of the specimen, obtaining the appropriate spectral reflectance factors (or tristimulus values if a colorimeter is used).

e) Calculate colorimetric values, if required, as described in clause A-8.4.

A-8.3.2 Standardization

Proper standardization of any colour measuring instrument is necessary in order to achieve more precise and accurate results. While different types of instruments require varying methods of standardization, there are common principles which shall be observed.

to general, instrument standardization involves measuring a clean white surface of known reflectance factors and calculating (through software built into the instrument or computer program) a series of correction factors which will be applied to subsequent measurements. Some instruments also require a black tile (or light trap), and possibly a grey tile. Each of these materials shall be maintained in its original clean, unscratched condition. Refer to the specific manufacturer's recommendations for cleaning instructions.

The frequency with which this standardization is performed depends on many factors including the type of instrument, the environmental conditions in which the instrument operates, and the required accuracy of the results. For most applications, an interval of 2 h to 4 h is acceptable.

Once the standardization step has been performed, it is important to verify the success of the procedure by measuring some coloured materials (verification standards) and comparing the resulting colorimetric values to the original values for these materials. If the measured values do not fall within an acceptable variation from their original values, the standardization is not considered valid. The number of verification standards and the acceptability limits depend on user requirements, but are typically 1 to 3 standards and an acceptance limit of 0,20 ΔECMC(2:1)D_{65}/10 units.

A-8.3.3 Sampling

All measurements taken on colour measuring instrumentation involve "sampling". The area-of-view of the instrument, the number of presentations averaged to produce a single measurement, the difficulty of presenting the specimen to the instrument, and the accuracy with which the sample represents the object of concern (garment, roll, dyelot, etc.) all play important parts in achieving meaningful and reproducible results.

A-8.3.4 Specimen preparation

The ideal specimen to measure is a rigid, non-textured, inert, opaque specimen of uniform colour. Such ideal specimens do not exist in textiles, so it becomes necessary to employ techniques and practices when measuring most textile materials which eliminate or reduce to acceptable levels the effect any specimen characteristics have on the instrumental colour measurement. Specific procedures and techniques for handling specimens which meet the following characteristics are presented in annex A.

a) Fluorescence of the specimen (from dyes or fluorescent whitening agents [FW As]) will influence the results depending on the amount of fluorescent material present and the amount and quality of ultraviolet and visible energy in the instrument light source. Results may be particularly hard to duplicate between instruments that do not have methods for calibrating the UV content. Example materials are white or lightly coloured materials treated with FW As.

b) Moisture content of textile materials can affect their colour and appearance characteristics. The amount of conditioning time necessary to achieve a stable moisture state varies with fibre, fabric construction, dyes and surrounding conditions. Examples of materials the colour of which are typically affected by moisture content are cotton and viscose materials.

c) Non-rigid specimens tend to protrude (or "pillow") into the viewing port of instruments. The amount of intrusion may vary depending on number of layers, softness of material and the backing pressure applied to mount the specimen. Variations in the amount of intrusion will result in significant deviations in the resulting colour measurement which are non-reproducible. Examples of these materials are fibre, yarn, knits, and layers of lightweight fabric.

d) Non-opaque specimens allow some light to pass through the material during measurement. Most textile materials, by nature of their structure, fit this category. During measurement, any light which passes through the material to reach the backing plate (or escape from the instrument) will yield false results. Examples of these materials are knits, lightweight materials and fibres.

e) Sensitivity of the specimen to light (photochromism) and/or heat (thermochromism) results in non-reproducible results, depending on the degree of sensitivity and the amount of time the specimen is exposed to undesirable conditions.

The photochromic properties of a specimen may be determined according to ISO 105-B05 : 1993.

f) Size of the specimen is important in obtaining a representative measurement by the instrument. When the specimen is too small for normal measurement, special techniques may be required to achieve a proper colour measurement.

g) Surface texture of the specimen (including pile lay, twill, gloss and lustre) affects the results of the colour measurement. The colour measurements of specimens with such physical characteristics are affected in different ways depending on the geometry of the instrument. Results between instruments of different geometries may be non-reproducible. Examples of these types of specimens are carpet, corduroy and wound yarn.

h) Variation in colour (non-uniformity) within the specimen, as related to the area-of-view of the instrument, can cause non-reproducible results. Examples are denim and leathers.

A-8.4 Method of calculation

Most calculations of colorimetric nature are performed by the software being used to operate the colour measuring instrument. In normal cases of reference to this method it will not be necessary for the user to perform these calculations, however they are described here as a means of reference and standardization for those who may need to perform such calculations.

A-8.4.1 Tristimulus values

The tristimulus values $\{X, Y, Z)$ are derived from spectral data and are the basis for all colorimetric calculations. The exact $(X, Y,$ Z) values derived from a set of spectral data depend on several factors including the wavelength range and interval of measurement and the user's choice of illuminant/observer functions used in the calculation.

A-8,4.2 CIE1976 L^*, a^*, b^* C_{ab} and h_{ab}

Calculate the L^*, a^*, b^* C_{ab} h_{ab} values from the X, Y, Z tristimulus values for both the standard and sample as follows:

$$L^* = 116\,(Y/Y_n)^{1/3} - 16 \qquad \text{if } Y/Y_n > 0{,}008\,856$$

$$L^* = 903{,}3\,(Y/Y_n) \qquad \text{if } Y/Y_n \leq 0{,}008\,856$$

$$a^* = 500\,[f\,(X/X_n) - f\,(Y/Y_n)]$$

$$b^* = 200\,[f\,(Y/Y_n)\mathrm{J} - f\,(Z/Z_n)]$$

where:

$(X/X_n) = (X/X_n)^{1/3}$ if $X/X_n > 0{,}008\ 856$

or

$f\,(X/X_n) = 7{,}787\ (X/X_n) \pm 16/116$ if $X/X_n \leq 0{,}008\ 856$

$f\,(Y/Y_n) = (Y/Y_n)^{1/3}$ if $Y/Y_n > 0{,}008\ 856$

or

$f\,(Y/Y_n) = 7{,}787\ (Y/Y_n) \pm 16/116$ if $Y/Y_n \leq 0{,}008\ 856$

$f\,(Z/Z_n) = (Z/Z_n)^{1/3}$ if $Z/Z_n > 0{,}008\ 856$

or

$f\,(7JZn) = 7{,}787\ (Z/ZJ \pm 16/116)$ if $Z/Zn \leq 0{,}008\ 856$

$Cab^{*} = (a^{*2} \pm b^{*2})^{1/2}$

h_{ab} = arctan(b^*/a^*) expressed on a 0° to 360° scale with the a^* positive semi-axis being 0° and the b^* positive semi-axis at 90°.

Thus

If $a^* > 0$ and $b^* > 0$, $0° < h_{ab} < 90°$

If $a^* < 0$ and $b^* > 0$, $90° < h_{ab} < 180°$

If $a^* < 0$ and $b^* < 0$, $180° < h_{ab} < 270°$

If $a^* > 0$ and $b^* < 0$, $270° < h_{ab} < 360°$

for these equations, Xn Y_n and Zn are the tristimulus values of the illuminant. For daylight the preferred illuminant/observer combination is D_{65}/10.

Table 1 gives the tristimulus values for all illuminant/observer combinations.

Table 1 -Tristimulus values for illuminant/observer combinations

(Clause A-8.4.2)

illuminant/observer combinations	Tristimulus values		
	Xn	***Vn***	***Zn***
Ten degree observer			
A/10°	111,146	100,000	35,200
C/10°	97,285	100,000	116,145
D$_{50}$/10	96,720	100,000	81,427
D$_{65}$/10	95,799	100,000	90,926
D$_{75}$/10	94,811'	100,000	107,304
F2/10^0 (cool white fluorescent 4 230 K)	94,416	100,000	120,641
F7/10^0 (daylight fluorescent 6 500 K)	103,279	100,000	69,027
F11/10° (ultralume 4 000 K and TL84)	95,792	100,000	107,686
	103,863	100,000	65,607
Two degree observer			
A/2°	95,792	100,000	35,585
C/2°	98,074	100,000	118,232
D$_{50}$/2	96,422	100,000	82,521
D$_{55}$/2	95,682	100,000	92,149
Dss/2	95,047	100,000	108,883
D$_{75}$/2	94,972	100,000	122,638
F2/2° (cool white fluorescent 4 230 K)	99,186	100,000	67,393
F7/2° (daylight fluorescent 6 500 K)	95,041	100,000	108,747
F11/2° (daylight fluorescent 4 000 K and TL84)	100,962	100,000	64,350

NATIONAL ANNEX B

(National Foreword)

COMMITTEE COMPOSITION

Chemical Methods of Test Sectional Committee, TXD 05

Organization	*Representative(s)*
Textiles Committee, Mumbai	**DR G. S. NADIGAR *(Chairman)*** SHRI E. VISHAMBHARAM *(Alternate)*
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Bapuji Institute of Engineering & Technology, Davangere	DR H. L. VIJAYAKUMAR **Dn** K. **MURUQESH** BABU *(Alternate)*
Central Institute for Research **on Cotton Technology,** Mumbai	**DR (MISS) C. R. RAJE** DR R. H. BALASUBRAMANYA ***(Alternate)***
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& **Weaving Mills Ltd, Bhilwara**	**MAJ GEN V.** BADHWAR SHRI VUAY YADAV *(Alternate)*
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Organization	*Representative(s)*
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The Bombay Textile Research Association, Mumbai	Shri A. V. Affini Shri B. S. Acharya (*Alternate*)
The South India Textile Research Association, Coimbatore	Representative
The Synthetics & Art Silk Mills' Research Association, Mumbai	Shri K. S. Taraporewala Shri D. L. Shah (*Alternate*)
Tex-n-Lab, Thane	Shri Ullas Nimkar Shri S. Vardarajan (*Alternate*)
Veermata Jijabai Technological Institute, Mumbai	Prof K. D. Gawand
Wool Research Association, Mumbai	Shrimati G. P. Rane Shri V. C. Panse (*Alternate*)
In personal capacity (2, *Shri Sidhi Vinayak Co-operative Housing Society, Swantra Veer Savarkar Marg, Worli, Mumbai*)	Shri M. D. Dixit
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Member Secretary
Shri M. S. Verma
Director and Head (Textiles), BIS

(Continued from second cover)

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 105-F10 : 1989 Textiles — Tests for colour fastness — Part F10: Specification for adjacent fabric: Multifibre	IS 15099 : 2002 Textiles — Method of test for colour fastness — Specification for multifibre adjacent fabrics	Technically Equivalent
ISO 105-J03 : 1995 Textiles — Tests for colour fastness — Part J03: Calculation of colour differences	IS 15098 : 2002 Textiles — Method for calculation of colour difference	do
ISO 3071 : 2005 Textiles — Determination of *p*H of aqueous extract	IS 1390 : 1983 Method for determination of *p*H value of aqueous extracts of textile materials (*first revision*)	do
ISO 3072 : 1975 Wool — Determination of solubility in alkali	IS 3429 : 1966 Method for determination of solubility of wool in alkali	do
ISO 3696 : 1987 Water for analytical laboratory use — Specification and test methods	IS 1070 : 1992 Reagent grade water (*third revision*)	do
ISO 3801 : 1977 Textiles — Woven fabrics — Determination of mass per unit length and mass per unit area	IS 1964 : 2001 Methods for determination of mass per unit length and mass per unit area of fabrics (*second revision*)	do

Technical Corrigendum 1 and 2 to the above International Standard has been given at the end of this publication.

This standard makes reference to following International Standards for which there are no Indian Standards. Extracts from these International Standards are given in National Annex A.

International Standard	*Title*
ISO 105-F: 1985	Textiles — Tests for colour fastness — Part F: Standard adjacent fabrics
ISO105-F01 :2001	Textiles — Tests for colour fastness — Part F01: Specification for wool adjacent fabric
ISO 105-F02: 2001	Textiles — Tests for colour fastness — Part F02: Specification for cotton and viscose adjacent fabric
ISO 105-F03: 2001	Textiles — Tests for colour fastness — Part F03: Specification for polyamide adjacent fabric
ISO 105-F04: 2001	Textiles — Tests for colour fastness — Part F04: Specification for polyester adjacent fabric
ISO 105-F05: 2001	Textiles — Tests for colour fastness — Part F05: Specification for acrylic adjacent fabric
ISO 105-F06: 2000	Textiles — Tests for colour fastness — Part F06: Specification for silk adjacent fabric
ISO 105-F07: 2001	Textiles — Tests for colour fastness — Part F07: Specification for secondry acetate adjacent fabric
ISO 105-J01 : 1997	Textiles — Tests for colour fastness — Part J01: General principles for measurement of surface colour

The composition of the Committee responsible for the formulation of this standard is given in National Annex B.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 :1960 'Rules for rounding off numerical values *{revised}*'-

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Amendments Issued Since Publication

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